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PATENT- OCH REGISTRERINGSVERKET

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A method in a telecommunication system

FIELD OF THE INVENTION

The present invention relates to a method for power control measurement information transfer in cellular systems.

BACKGROUND OF THE INVENTION

In cellular radio systems, it is beneficial not to transmit with higher power levels than necessary to fulfill determined quality requirements, e.g. to reduce the transmitter powers to the lowest possible level where the receiving antennas can still identify the transmitted signals from the noisy channels. In particular, the (mobile-to-fixed direction or) uplink of Code Division Multiple Access (CDMA) systems has turned out to thrive from dynamic power level adjustments where none of the (mobile) terminals are using more transmitter power than is required to fulfill their communication quality demands. One of the most important factors for the operation of power control mechanisms is reliable communication quality measurement.

The most essential parts of the uplink power management mechanism are normally placed in the radio network controller due to the soft-handoffs where multiple receiving nodes can be simultaneously involved in the reception of transmitted data. A crucial part of the current uplink power control techniques is therefore the communication quality measurement information transfer over the transport network interfaces within the radio access network.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a model of communication quality measurements and power control information transfer during soft-handoffs.

DESCRIPTION OF THE INVENTION

The present invention refers to the fact that the placement of new retransmission protocols in the 3G systems uplink may degrade the communication quality measurements, i.e. the introduction of new retransmission protocols that are placed very close to the radio interface interacts in an undesirable manner with the state-of-the-art power control techniques. Therefore, the present invention relates to improved measurement information transfer methods that can overcome the difficulty. For the sake of simplicity, the present invention is described from the point of view of the WCDMA standard; although the invention is applicable for other cellular – not necessarily only CDMA – standards as well.

The following describes the current communication quality measurement methods and the measurement information transfer procedures as suggested in the document "UTRAN Iub/Iur interface user plane protocol for DCH data streams", 3GPP TS25.427 v5.1.0 (2002-12) issued by the 3rd Generation Partnership Project; Technical Specification Group Radio Access Network. These measurements and procedures are described for the uplink direction by using the system model shown in the figure 1. In this model, a soft-handoff scenario is shown where two different receiving nodes receive transport blocks from the same transmitting mobile terminal. In other words, there are two different decoders that may simultaneously decode the same transport block.

The decoded transport blocks are delivered to a diversity-combining unit that is placed in the radio network

controller. The diversity combining is based on some (raw) measurement data that is provided by the receiving node. In WCDMA standard, the measurement data consists of both cyclic redundancy checksum indicators (CRCI) and quality estimates (QE). The CRCI indicates the correctness/incorrectness of the transport block and the QE represents the experienced transport channel bit error-rate (BER).

In turn the uplink power control technique is composed of multiple control loops. The receiver uses an inner and outer loop control where the actual (experienced) signal-to-noise ratio (SNR) is measured and compared with a target value. Using the outcome from the comparisons power control commands are computed and further sent to the transmitter. The purpose of the transferred control commands is either to increase or decrease the transmitter power level in order to obtain the target SNR at the receiver. Observe that during soft-handoffs the transmitter receives power control commands from two different, and independent, inner loops.

The target SNR is determined by an outer loop control scheme. The main objective of outer control loop is to iteratively adjust the SNR target value in such a way that the estimated block error rate (BLER) agrees with a BLER target value. Moreover, the outer loop control is placed in the radio network controller in order to assign the same SNR target for different (independent) inner loops during the soft-handoffs. Unlike the inner loop, the outer loop is driven by the processed measurement data from the diversity-combining unit.

In general, a robust error correction scheme can be useful in order to bring down the transmitter power levels as much as possible. One attractive error control technique is the class of automatic repeat request (ARQ) protocols that can guarantee reliable information transfer over extremely noisy

radio channels. The main principle is that the receiving side can take advantage of a return channel by sending retransmission requests of erroneous (and/or missing) data units to the transmitting side. Similar to the power management mechanisms, the ARQ functionality is normally placed in the radio network controller above the diversity combining functionality.

In order to make more efficient use of retransmissions, the introduction of additional ARQ based error correction schemes – that are placed closer to the radio interface – has been identified as an important study item for the 3G systems uplink evolution. If a retransmission protocol is, as proposed, introduced between the decoder and the diversity-combining unit then some of the erroneous transport blocks are discarded and/or retransmitted before diversity combining. A problem arises, since both the discarding and the retransmissions make the actual transport channel errors, i.e. transmission errors over the radio interface, invisible for the outer loop control scheme.

It is therefore motivated that the architectural change, where the uplink power control scheme and the ARQ functionality are placed in different nodes, gives rise to a refinement of some measurement information transfer procedures between the receiving nodes and the network controller.

In order to make sure that the transport channels are always visible for the outer loop control scheme, some additional measurements are imposed. The main principle is that the raw measurements for the diversity-combining unit are retained but the outer loop control mechanism is provided with some additional information about the requested retransmissions and transmission attempts. The present invention therefore proposes the following three measurement methods:

Decoding Failure Indicator Bit: As soon as an error-free transport block is obtained an acknowledgement is sent to the transmitter and the block is forwarded to the radio network controller. Otherwise, a negative acknowledgement is sent to the transmitter and an error-event indicator bit is sent to the radio network controller. The indicator bit is used by the outer loop scheme in order to estimate the number of actual transport channel errors. In the soft-handoffs, indicator bits from several different receiving nodes are combined using logical operations and therefore it is ensured that the same error event is never counted more than once.

Decoding Failure Indicator Bitmap: As the decoding failure events can be frequent, the receiving node can send, at regular basis, a bitmap that indicates the number of decoding failures for the forwarded transport blocks to the radio network controller. The bitmap is used by the outer loop scheme in order to estimate the number of actual transport channel errors. In the soft-handoffs, bitmaps from several different receiving nodes are combined. Consequently, it can be ensured that the same transport channel errors are never counted more than once.

Decoding Failure Statistics: As the bitmaps can be sometimes very large, it can be useful to pre-process the measurement data before it is sent to the control loop. One possible method is to send, again at regular basis, some statistics, e.g. the rate of decoding failures and/or retransmission requests, for the forwarded transport blocks. A drawback of this method is the over-estimation of channel errors because some of the error events are counted more than once.

Transmission Attempt Information: A straightforward and reliable method is to collect some transmission attempt statistics already at the mobile transmitter and deliver

that statistics to the outer loop control. Consequently, the problems of combining and/or over-estimation can be omitted. A drawback is that the measurement information should be transferred over the radio interface, which in turn consumes scarce transmitter power resources and shortens the battery lifetime.

The present invention can ensure that the operation of uplink outer loop power control can be based on the actual transport channel errors even if a retransmission protocol that can correct the channel errors is introduced between the control loop and the decoder. It is therefore possible to concurrently make use of accurate outer loop power control and fast retransmission protocols although the different functionalities are placed in different network nodes.

CLAIMS

1. A method in a network controller of a cellular system for concurrent error-event driven power control loop and error correction with feedback in the uplink of a cellular radio network, where the error correction system is in the receiving network node and the control loop is in the network controller, comprising the step of

receiving an indication of the number of decoding failures from the receiving node to the radio network controller,

computing the experienced transport channel block error rate based on the transmission attempts indicators,

computing a target value for the transmitting mobile terminals as a function of the indicators.

2. The method according to claim 1, wherein the computed target value is at least the signal quality.

3. The method according to claim 1 or 2, wherein the computed target value is at least the signal-to-noise ratio.

4. A method in a receiving node of a cellular system for concurrent error-event driven power control loop and error correction with feedback in the uplink of a cellular radio network, where the error correction system is in the receiving network node and the control loop is in the network controller, comprising the step of indicating the number of decoding failures to the radio network controller.

5. The method according to claim 4, whereby the step of indicating the decoding failures comprises at least the step of sending the exact numbers of decoding failures to the radio network controller.

6. The method according to claim 4, wherein the step of indicating the decoding failures comprises at least the step

of sending pre-processed decoding failure statistics to the radio network controller.

7. The method according to claim 4, wherein the step of indicating the decoding failures comprises at least the step of sending the exact numbers of transmission attempts reported by a mobile terminal.

6. The method according to claim 4, wherein the step of indicating the decoding failures comprises at least the step of sending pre-processed transmission attempt statistics reported by the mobile terminal.

7. The method according to claim 5, wherein the step of sending the exact numbers of decoding failures comprises the step of indicating separately each individual decoding failure event.

8. The method according to claim 5, wherein the step of sending the exact numbers of decoding failures comprises the step of indicating a bitmap of individual decoding failure events.

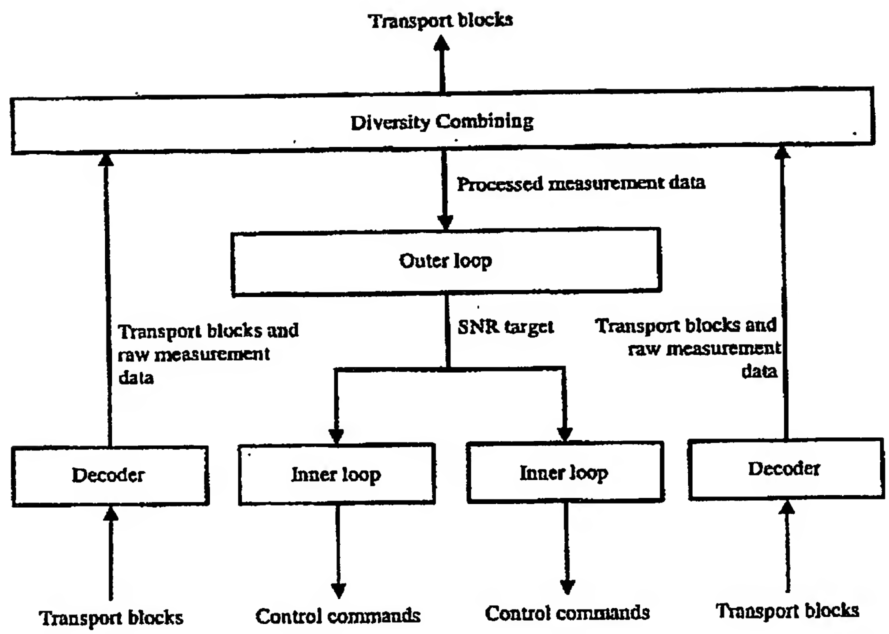
Transport blocks
Diversity Combining
Processed measurement data
Outer loop
Transport blocks and raw measurement data
SNR target
Transport blocks and raw measurement data
Decoder
Inner loop
Inner loop
Decoder
Transport blocks
Control commands
Control commands
Transport blocks

Figure 1